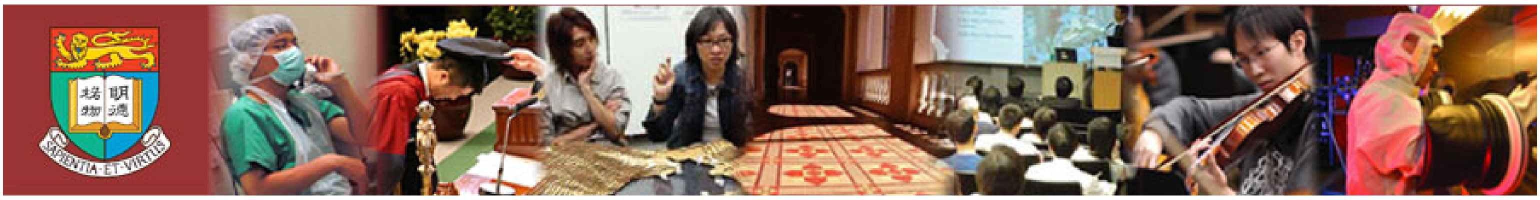

Title	Can speech sound ability predict literacy skills in Cantonese-speaking preschoolers?
Author(s)	Man, Hiu-tung; 文曉彤
Citation	Man, H. [文曉彤]. (2014). Can speech sound ability predict literacy skills in Cantonese-speaking preschoolers?. (Thesis). University of Hong Kong, Pokfulam, Hong Kong SAR.
Issued Date	2014
URL	http://hdl.handle.net/10722/238929
Rights	The author retains all proprietary rights, (such as patent rights) and the right to use in future works.; This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

Can Speech Sound Ability Predict Literacy Skills in Cantonese-speaking Preschoolers?

Man Hiu Tung

A dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science (Speech and Hearing Sciences), The University of Hong Kong, June 30, 2014.

Can Speech Sound Ability Predict Literacy Skills in Cantonese-speaking Preschoolers?

Man Hiu Tung

Abstract

The present study examined the association of early speech sound ability of Cantonese-speaking preschoolers on their later literacy outcomes. Nineteen children who participated in a previous study on validation of a parent questionnaire of speech were assessed on their literacy skills one year later (Time 2). Thirteen of them had a history of speech sound disorder (SSD) and 6 did not. All of them showed age-appropriate language skills at the second time point and they received no prior speech therapy. Speech sound abilities at both time points were measured in terms of the percentage of initial consonants correct (PICC) using a standardized speech assessment. Literacy skills were measured in terms of word reading scores using a standardized literacy screening for preschoolers. PICC in the first time point (Time 1) was significantly correlated with word reading. However, the contribution of PICC at Time 1 became nonsignificant when PICC at Time 2 was taken into account. The findings appeared to support Multiple Deficit View which claimed that the reading outcome depended on the interplay between phonological deficit and other factors such as language ability. Future study directions were discussed.

Introduction

There is extensive overlap among a range of developmental disorders which are considered distinct categorical disorders in the current clinical practice. For example, most children with autism spectrum disorders are often comorbid with intellectual disabilities. Another example is the overlap between children with speech sound disorders and reading disabilities. Speech sound disorder (SSD) involves impairment in the phonological domains and is characterized by developmentally inappropriate speech errors (Smith, Pennington, Boada, & Shriberg, 2005). Reading disability (RD) or developmental dyslexia is a specific learning difficulty concerning one's word decoding skills. It is defined by the British Dyslexic Association (BDA) Management Board (2007) as an impaired ability to read with difficulties in phonological processing, processing speed, working memory and rapid naming. There is ample evidence indicating that childhood SSD would lead to an increased risk of subsequent RD (Bird, Bishop, & Freeman, 1995; Leitao & Fletcher, 2004; Raitano, Pennington, Tunick, Boada, & Shriberg, 2004; Snowling, Bishop, & Stothard, 2000). Children with RD, conversely, also exhibit heightened SSD rate in preschool years (Pennington & Lefly, 2001). With the comorbidity rate of almost 30% (Pennington & Lefly, 2001), the association between SSD and RD appeared to be evident.

There were two different hypotheses to account for the underlying cognitive deficits that contribute to RD, namely the Core Phonological Deficit Hypothesis and the Multiple Deficit View.

Core Phonological Deficit Hypothesis

According to Core Phonological Deficit Hypothesis proposed by Stanovich (1986), phonemic sensitivity and other phonologically related abilities were found to be the core faculty for word recognition in later years for children with reading problems, at least for those learning alphabetic languages. Deficient phonological processing skills, including phonological awareness (PA), verbal memory, and efficiency of retrieving phonological representations could contribute to RD even though the phonological deficit was mild. Rvachew and Grawburg (2006) suggested that PA in phonemic level was pivotal in predicting the emergent literacy skills in English. Due to the underperformance in PA in children with mild to severe SSD, several researchers had outlined the role of PA as a mediator between expressive phonology and word reading (Anthony, Aghara, Dunkelberger, Anthony, Williams, & Zhang, 2011) and the relationship was found to be independent of language status (Gernand & Moran, 2007; Rvachew & Grawburg, 2006).

In addition to weakness in PA, phonological representation-related difficulties in both expressive and receptive phonology were prevalent in children with SSD. Phonological representations contain phonological features of words stored in the mental lexicons (Rvachew, 2007). Since impairments in phonological representation might underlie weakness in PA (Elbro, Borstrom, & Peterson, 1998), children with weak phonological representations tended to be slow learner to read and had higher risk of reading failure (Rvachew, 2007). In the meantime, children with RD often demonstrated deficits in forming and retrieving phonological representations (Swan & Goswami, 1997). These again provided evidence to the Core Phonological Deficit Hypothesis.

Multiple Deficit View

Some study findings revealed that the relationship between SSD and RD would be more complex. RD seemed to be attributable to problems in two or more cognitive constructs, leading to the emergence of the Multiple Deficit View (Pennington, 2006). The hypothesis held that children with phonological processing deficits were vulnerable to later RD, but it was the interaction between phonological deficit and other risk and protective factors that played a decisive role in the final literacy outcomes (Pennington, 2006). In other words, phonological deficits alone were not sufficient to predict literacy. A large body of studies pointed to the importance of taking into account of one's language ability when considering the association between SSD and RD. It has long been recognized that superior language skills, particularly oral language ability, could lead to positive outcomes in PA and lexical representations restructuring (Metsala, 1999), thereby enhancing literacy acquisition. Strong correlation between language impairment and literacy difficulties among school-aged children were also found (McArthur, Hogben, Edwards, Heath, & Mengler, 2000), suggesting that language ability could highly reflect reading performance. The study by Raitano et al. (2004) revealed that children with SSD and concomitant LI exhibited an increased risk of RD whereas reading impairment in children with isolated SSD, that is, speech deficits without LI, was relatively small. Peterson, Pennington, Shriberg, and Boada (2009), together with Sices, Taylor, Freebairn, Hansen, and Lewis (2007), shared a similar view about the role of oral language ability in the interplay of SSD and RD and they reported that the association between speech sound ability and literacy was not significant unless language skills had been taken into consideration. Related findings were reported in studies that compared the performance of children with isolated SSD with matched normal controls in reading tasks and found no significant difference between the two groups (e.g. Nathan, Stackhouse, Goulandris, & Snowling, 2004; Snowling et al., 2000).

The inconsistency of the findings may be due to several limitations in methodologies (Peterson et al., 2009). One of the reasons is that the exclusionary criteria for subject selection were not well-defined in some of the studies. For instance, the participants' language abilities were not controlled in the study by Leitao and Fletcher (2004), casting doubt on the sole contribution of speech problems. Besides, the results obtained may not be reliable owing to the undesirable sample size. For example, there were merely 10 participants with isolated SSD history in Snowling et al. (2000)'s study. Therefore, the association between SSD and RD still remains unclear and warrants further investigation.

In addition to the mixed findings in the literacy outcome of children with speech deficits in the literatures, the correlation between SSD and RD in non-alphabetic languages is still largely unexplained. The studies reviewed above focused on children who speak an alphabetic language where the correspondence between the symbols used in the written language and the pronunciation is generally quite regular, that means, each letter may represent a fixed set of sounds in spoken words. On the other hand, studies concerning the association between SSD and RD in children who speak a non-alphabetic language or an opaque language where the symbol-sound correspondence is less clear are relatively scant. The present study aimed to examine whether the above relationship was also noted in a non-alphabetic script, that is, Chinese.

Reading Ability in Children Learning Chinese

A vast majority of Chinese characters are comprised of a semantic radical and a phonetic component (Zhu, 1987). The radical of a character carries semantic information. For instance, the word 爐[lou4], which means "stove", has a radical of 火 that represents fire. The phonetic component 盧[lou4], on the other hand, can provide hints about the pronunciation of the character when it follows either the regularity or consistency rule. Therefore, despite no explicit grapheme-to-phoneme conversion required, phonological information in the orthography appeared to play a part in Chinese reading (Ho & Bryant, 1997b). Some studies described that the developmental pattern in children learning Chinese was generally similar to that for alphabetic scripts. Chinese children as young as 3 years old started to show PA-related ability (Ho & Bryant, 1997a). Among the many aspects of PA, syllabic and onset-rime awareness were found to be particularly important in the recognition of Chinese characters (Ho & Bryant, 1997c; Hu & Catts, 1998; McBride-Chang & Ho, 2000). Moreover, children with impaired verbal memory often exhibit difficulties in learning new words (Gathercole & Baddeley, 1989; Ho, Law, & Ng, 2000). Association between verbal memory and Chinese reading success in both children with RD and typical children had been supported. The above evidence appeared to point to the fact that phonological difficulties in terms of PA might be predictive of later literacy in Chinese (Ho & Bryant, 1997c; Ho, Chan, Chung, Lee, & Tsang, 2007; Ho, et al., 2000). This suggests that Core Phonological Deficit Hypothesis might also be applicable to Chinese.

However, the contribution of phonological-related difficulties in early Chinese reading development was controversial. Some studies suggested that the role of phonological skills in Chinese readings only became more important when children entered primary schools or when they studied in higher grades such as Primary 5 and 6 (Chan & Siegel, 2001; Siok & Fletcher, 2001). There were also doubts on whether the contribution of PA in reading was related to Chinese orthography (Ho, Chan, Lee, Tsang, & Luan, 2004).

Besides, Multiple Deficit View also had supporting evidence in Chinese RD in the literature. Apart from phonological difficulties, there are some other cognitive-linguistic deficits that may be related to RD in Chinese. For example, orthographic and visual processing skills are two of the cognitive constructs that are crucial for the learning of Chinese characters during preschool years (Ho et al., 2004; Ho, Ng, & Ng, 2003; Siok & Fletcher, 2001). Demonstrating the awareness to extract the character meaning from the semantic radical is relevant to advanced reading skills (Shu & Anderson, 1997). It was noted that most Chinese children with RD often found it difficult to acquire this type of orthographic knowledge (Ho et al., 2004; Ho et al., 2007). Moreover, since Chinese characters are visually complicated and Hong Kong young children mainly learn the sounds of different characters by rote, paired visual-verbal associate learning (visual-verbal PAL), which refers to the ability to match the visual presentation of the character with its verbal information, is also considered to be of importance in Chinese (Ho, Leung, & Cheung, 2011).

Resembling the alphabetic counterparts, Chinese children with more sophisticated reading ability often have superior oral language skills (Ho et al., 2011). Chinese is a morphosyllabic script. Morphological awareness, which is a language ability that involves relating speech sounds to meaning, is crucial in Chinese character reading given the prominence of multisyllabic compounds and homophones in Chinese words (Ho, 2010). It was reported to be the most sensitive measure to identify Chinese children with RD (Shu, McBride-Chang, Wu, & Liu, 2006). Its significance in assisting Chinese children in character recognition is well-established and it especially plays a role in Chinese character reading in preschoolers (McBride-Chang, Liu, Wong, Wong, & Shu, 2012; Wong, Kidd, Ho, & Au, 2010).

The Present Study

The present study aims at investigating whether isolated speech sound difficulties place Cantonese-speaking preschoolers at risk of poorer literacy skills. It was hypothesized that Core Phonological Deficit Hypothesis fitted more to Chinese RD than Multiple Deficit View. There were two reasons why we hypothesized speech sound ability was predictive of the reading performance in Chinese children under investigation. Firstly, according to the definition of Dyslexia by the BDA Management Board (2007), difficulties in phonological processing are one of the key characteristics of RD. This highlights the pivotal role played by phonological processing, which is an overt symptom of SSD. Given PA is equally important in Chinese reading as suggested by various dyslexia researchers (eg., Ho et al., 2000; Siok & Fletcher, 2001), it is likely that SSD may predict later literacy outcome in Chinese preschoolers. Secondly, the effectiveness of the trainings on phonological strategies was well-established in enhancing literacy for Chinese children with RD (Ho & Ma, 1999). It is plausible that stronger phonological skills can lead to improved reading abilities in later time.

Method

Participants

The present study followed up part of the cohort in Ng, To, and McLeod (2014) which was a validation study of the Intelligibility in Context Scale -Traditional Chinese (ICS-TC), a parent-report questionnaire on speech sound ability in Cantonese-speaking children.

There were a total of 72 participants in the study of Ng et al. (2014) at the first assessment (Time 1). In their study, the diagnosis of SSD was based on two considerations in their performances in the Hong Kong Cantonese Articulation Test (HKCAT) (Cheung, Ng, & To, 2006), a standardized speech assessment in Hong Kong. If a child showed deviant errors that are not shown by more than 95% of the age-matched peers in the normative sample and obtained a standard score at or below -1.33 SD from the mean for initial consonants, vowels and diphthongs or final consonants, he/she was considered as having SSD.

Due to technical problems in the recordings, data collected in one kindergarten were not included in the study of Ng et al. (2014). Both the demographic information and HKCAT performances at Time 1 were retrieved from the database. Since high intra-rater (98.3%) and inter-rater reliability (95.7%) were reported, it is assumed that the online charting of the speech performance for this group of participants during Time 1, albeit no recordings available for reliability check, can genuinely reflect their speech abilities at that time.

To avoid dialectal impact, only participants who use Cantonese as their home language were included. Exclusionary criteria were the presence of diagnosis or concern of other developmental disabilities including Autism Spectrum Disorder and language delay, hearing loss, visual problems, history of receiving speech therapy and deficits in the peripheral speech articulators such as cleft lip and palate.

All eligible children were invited for the present study one year after the first assessment (Time 2). There were 47 respondents, with 21 participants in Kindergarten 2 (K2), 18 in K3 and 9 in Primary 1 (P1), yielding response rates of 65.6%, 81.8% and 27.3% respectively. The P1 group was difficult to trace because they were promoted to different primary schools. Owing to the high dropout rates, P1 participants were not included for current analysis. Three K3children were excluded as they were reported to have language delay by their parents.

To ensure all participants meeting the inclusionary criteria of having normal language, the Hong Kong Cantonese Receptive Vocabulary Test (HKCRVT) (Lee, Lee, & Cheung, 1996), which is a standardized test for assessing receptive vocabulary comprehension in children aged between 2;0 and 6;0 was performed. Participants were requested to select the target picture upon the vocabulary heard and only those with scores at least -1.25SD below the mean in the normative data were included in the analysis. After conducting the assessment, 2 K2 and 1 K3 children failed in the HKCRVT and were excluded. In order to control for the effect of the age factor, only children studying in K2 were included in the present study. Among them, 13 belonged to the SSD group while 6 were categorized in the Typical group during Time 1. The flow of the study is illustrated in Figure 1.

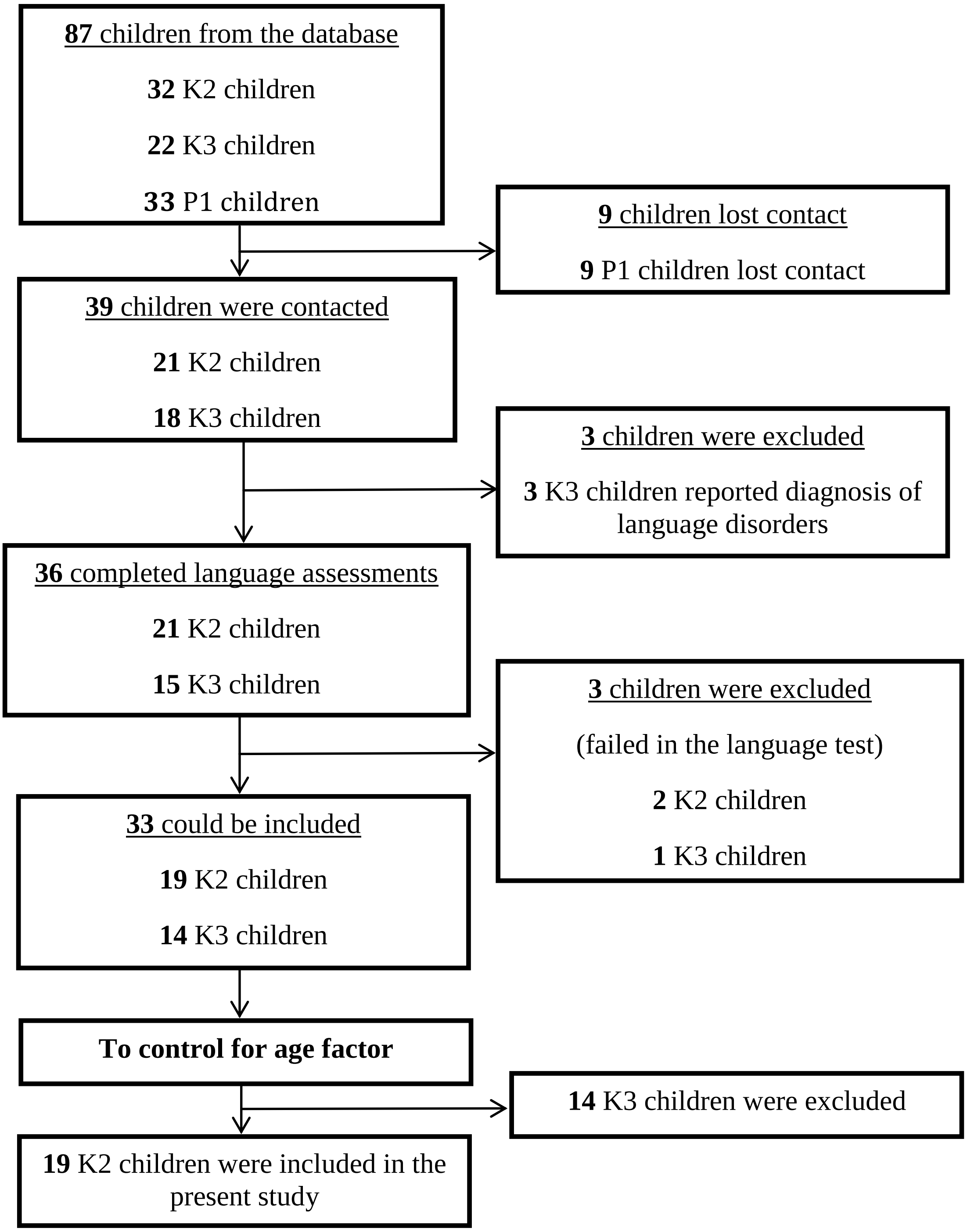

Figure 1. Flowchart of the number of participants of the present study.

Eleven K2 children declined to participate in the present study and they all had histories of SSD. Given that the response rate is low, the demographic background and the speech sound production ability of the participating SSD children (n = 13) were compared with the dropout SSD children (n = 11). This is to ensure that the present sample was representative of the original group. Demographic data collected at Time 1 were retrieved. Socioeconomic status was based on a trichotomy of the percentiles of the family incomes according to the 2011 census figures in Hong Kong (Census and Statistics Department, 2012): (1) below 25th percentile, (2) between 25th and 75th percentile and (3) above 75th percentile. As displayed in Table 1, there are no significant differences between the SSD group and the dropout group on age [$t(22) = .017$, $p = .986$], speech measures [$t(22) = .052$, $p = .822$], gender [$\chi^2(1, N = 24) = 0.084$, $p = .772$], and socioeconomic status [$\chi^2(2, N = 23) = 1.104$, $p = .576$], suggesting that the children with SSD history who had been included in the present study for analysis were representative of the original SSD sample and were not biased.

Table 1
Means (standard deviation) on Demographic Variables for the Participating SSD and Dropout SSD groups

Demographic variables	Participating Group M (SD)	Dropout Group M (SD)
N	13	11
PICC	82.53 (17.04)	86.18 (19.01)
Age (in months)	41.15 (3.93)	41.18 (3.95)
Male (%)	69.2%	63.6%
Family income*(percentile)		
< 25th (%)	23.08%	30%
25th - 75th (%)	69.23%	50%
> 75th (%)	7.69%	20%

* One dropout did not respond to family income during Time 1
Note. PICC=Percentage of Initial Consonants Correct

In addition, as presented in Table 2, four children in the SSD group have resolved his/her speech problems 1 year later. On the other hand, among the 6 preschoolers in the

Typical group, two were found to be at risk for SSD at later time point. In the present study, the classification of SSD group and Typical group was based on the diagnosis of SSD at Time 1.

Table 2
Participant Characteristics

	Age (months)		Gender		Speech status at Time 1		Speech status at Time 2	
	Range	*M* (*SD*)	Male	Female	SSD	Typical	SSD	Typical
K2 participants (*N* = 19)	49-60	54 (3.41)	12	7	13	6	11	8

Procedures and Measures

Teachers of the five preschools were contacted to assist in the tracking of the participants. Parents who could be approached received an invitation letter which explained the objective of the study from the teachers. They then signed the consent form and returned it with a questionnaire requesting demographic information including the child and the caregivers' first language, history of receiving therapies and diagnosis of any developmental disabilities including hearing loss, visual problems and language delay.

All participants were assessed individually either in their preschools or in a quiet room in a Community Hall lasting for about 30 to 45 minutes. HKCRVT (Lee et al., 1996) was conducted to ensure all children showed age-appropriate language. Two assessments, namely the HKCAT (Cheung, et al., 2006) and the Hong Kong Reading Ability Screening Test for Preschool Children (RAST-K) (Ho, et al., 2011) were conducted. Examiner who administered the tests was blinded to the Time 1 speech sound abilities of the children to avoid judgmental bias.

Speech Samples

At both Time 1 and Time 2, speech performance was measured using a standardized speech assessment, HKCAT (Cheung et al., 2006) which examines all Cantonese initial consonants, vowels, diphthongs, and final consonants.

The full marks for initial consonants, vowels and diphthongs, and final consonants are 48, 29 and 16 respectively. Various measures were calculated, namely the percentage of initial consonants correct (PICC), the percentage of vowels/diphthongs consonants correct (PV/VVC), the percentage of final consonants correct (PFCC) and the number of tonal errors.

All participants passed the standard score in PFCC. Only one participant achieved -1.33SD or below for PV/VVC. No tonal errors were noted. Therefore, the number of participant who failed in PV/VVC was too small to allow meaningful statistical analyses. It was assumed in the present study that PICC were generally indicative of the speech sound ability of the child.

Literacy

RAST-K (Ho et al., 2011) was administered. It is a standardized screening tool for preschoolers at high risk of RD with reliability of 0.97. There were two separate test materials for kindergarteners in grade 2 and 3 and that specifically designed for K2 children was administered for the participants during Time 2. It included a Chinese Word Reading task in which participants were required to read 30 Chinese characters and 25 Chinese two-character words one by one. One mark was given for each correctly produced test item and the full marks of the test were 55.

Results

Prediction of literacy skills was examined in two different ways. Firstly, the mean score of the literacy test in the SSD group during Time 1 was compared to that in the Typical group during Time 1. Secondly, correlations and a regression analysis were used to investigate whether the speech status at Time 1 could predict literacy skills after the speech status at Time 2 was controlled.

Table 3 displays the descriptive statistics of all the participating children on speech and literacy measures. There was an evident improvement in the preschoolers' PICC after 1 year. Since a majority of preschoolers in Hong Kong started to read at K1 and the word exposure was still rather limited in K2, the highest word reading score obtained by the group was 17.

Table 3

Overall Performance on PICC and Word Reading Ability

Measures	*M*	*SD*	Range
PICC at Time 1 (%)	83.77	16.69	41.67 - 100
PICC at Time 2 (%)	95.07	6.78	77.08 - 100
Word reading scores at Time 2	7.95	6.20	0 - 17

To examine whether the diagnosis of SSD at Time 1 resulted in poorer word reading performances at a later time point, the word reading scores in SSD group (n = 13) were compared to those of the Typical group (n = 6) (see Table 4). Since the distribution of the word reading scores in both groups were rather skewed, medium was used over mean as a measure of central tendency. The literacy skills of the SSD group were poorer than that of the Typical group as reflected in the word reading scores, suggesting that deficits in speech sound during early years may to some extent be associated with subsequent word reading difficulties.

Table 4
Speech Measures and Word Reading Scores of the SSD and Typical Groups

	Time 1		Time 2		
	PICC	Number of atypical errors	PICC	Reading scores	
Groups	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*Mdn*	*SD*
SSD group (n = 13)	77.73 (17.00)	7.85 (6.53)	92.95 (7.29)	6	6.24
Typical group (n = 6)	95.84 (2.91)	0 (0.00)	99.65 (0.85)	7.5	6.66

Bivariate Correlations

The correlations between Time 1 PICC, Time 2 PICC and word reading scores in RAST-K of all the children were calculated. The PICC at Time 1 was found to be significantly correlated with the word reading scores in RAST-K (r = .515, p < .05) whereas no significant correlation was noted between PICC at Time 2 and word reading (r = .365, p = .062) if the traditional significance level of 0.05 was adopted. Nevertheless, given the unanimous results in past literatures about the predictive relationship of speech sound ability on word and the possibility that the traditional cutoff p value 0.05 may overlook variables which may be crucial (Bursac, Gauss, Williams, & Hosmer, 2007), PICC at Time 2 was also included in the multiple regression model in order to control for its effect.

Multiple Regression Analyses

Multiple regression analyses were implemented to examine the effects of two predictor variables including PICC at Time 1 and PICC at Time 2 in predicting preschoolers' word reading performance in RAST-K. This method was adopted for its effectiveness in controlling confounding variables that were out of the scope in the present study as well as gaining an insight into the unique contribution of each independent variable. Several assumptions of multiple regression analysis were met. The word reading score was continuous. Tolerance for PICC at Time 1 and Time 2 were both 0.488, reflecting a low level of multicollinearity.

Variables were added to the model in a stepwise fashion to investigate the unique contributions of different variables of interest: PICC at Time 1 was entered first as it was shown to be significantly correlated with the word reading score (r = .515, p < 0.05). PICC at Time 2 was then entered into the equation to determine whether it accounted for any additional variance that predicted the word reading scores. Table 5 reveals the results of the multiple regression analysis for PICC at Time 2. PICC at Time 1 accounted for 26.5% of the variance in the outcome measure in the first step. In the second step, PICC at Time 2 was entered and it did not significantly explain any unique variance in word reading scores. The significance of PICC at Time 1 was also lost. These indicated that speech sound ability was not a useful predictor of the word reading performance when speech ability at later stage was also taken into account.

Table 5

Hierarchical Multiple Regression Model Regressing PICC at Time 1 and Time 2 on Word Reading Performance

Predictor variables	*df*	*B*	R^2	ΔR^2	*F*
Step 1	1		0.265	0.265	6.141*
PICC at Time 1		.515			
Step 2	2		0.265	0.00	2.890
PICC at Time 1		.520			
PICC at Time 2		-.006			

*p<.05

Discussion

The present study explored the effect of speech sound ability on preschool children's word reading in Cantonese. There was a substantial increase in PICC for the whole participating group, which paralleled with the prior studies by Shriberg (1994) suggesting that nearly three quarters of children with SSD were able to have their speech difficulties resolved by the age of 6. The finding demonstrated that SSD status was positively associated with Chinese character reading scores, which was in line with the previous studies claiming that phonological processing as measured by PA was also important in literacy development in Chinese (Ho & Bryant, 1997c). However, only PICC at Time 1 was significantly correlated with the word reading scores while PICC at Time 2 did not. This correlation was consistent with some literature findings on English that phonological difficulties at the onset of reading, that is early preschool, were more directly concerned with reading success (Bradley & Bryant, 1985; Snowling et al., 2000). However, the phonological components that predict the literacy outcome in Chinese preschoolers may be different from those predicting their English counterparts. Whitehurst and Fischel (2000) explained that PA is fundamentally related to emergent literacy in alphabetic scripts as it is the prerequisite for word decoding. In Hong Kong, on the other hand, verbal memory may be more relevant during preschool years. Hong Kong children commonly adopt the "look and say" method during their early stage of learning to read and they are required to learn the pronunciations of Chinese words by rote (McBride-Chang et al., 2005). It seems that intact verbal memory is essential in this phase so that transferal to long-term memory can be made. Given that the regularity and consistency rules are indirectly acquired via exposure to a considerable number of Chinese characters (Ho & Bryant, 1997c), impaired verbal memory during onset of character reading learning may lead to insufficient storage of phonological representations, thus hindering the acquisition of phonological strategies. Echoing the study of Ho et al. (2000), it may predispose Chinese children with poor verbal memory to later RD. This might account for the significant moderate correlation between phonological processing and word reading at the early time point suggesting that less sophisticated speech sound production ability may be likely to have lower word reading scores. It also supported previous studies that history of SSD would constitute a hurdle for children in reading even though spontaneous recovery takes place later (Bird et al., 1995; Leitao & Fletcher, 2004; Peterson et al., 2009; Raitano et al., 2004).

Nevertheless, the whole regression model was insignificant when PICC at Time 2 was entered, implying that RD does not necessarily develop if a child has a history of SSD. As suggested in the Core Phonological Deficit Hypothesis (Stanovich, 1986), both RD and SSD share a common impairment in phonological processing and this phonological deficit is the fundamental cognitive construct that underlies RD. According to this view, PICC at Time 1 should be able to predict later literacy outcome. Contrary to this hypothesis, the findings of the present study were more in line with the Multiple Deficit View that were put forward by Pennington (2006). Although SSD history seems to increase the risk to the character reading performance, there should be some additional factors, together with speech sound ability, that determine the outcome. Children in the present study only had phonological-related deficits and age-appropriate language skills (i.e., isolated SSD). It was possible that their intact language abilities might serve as a protective factor, allowing them to use language strategies and cognitive resources more effectively for compensation of their phonological difficulties during character reading. Therefore, notwithstanding the possibility of elevated risk of SSD on RD, SSD alone might not be very influential in determining the final literacy outcomes. This also explained why the prediction significance of PICC at Time 1 was lost after Time 2 PICC was included in the model.

Morphological awareness and visual-verbal PAL skills, although not examined in the present study, were also two possible protective factors. Morphological awareness has been regarded as a significant predictor of literacy success in Chinese for both typical children and children with RD (McBride-Chang et al., 2012; Shu et al., 2006; Wong et al., 2010) and it appears to be more predictive of literacy success than PA in Chinese in general (Ho et al., 2012; McBride-Chang et al., 2005). Moreover, visual-verbal PAL skill plays a role in the "look and say" education method in Hong Kong context (Ho, 2010) and it may be a more useful predictor of literacy outcome in early Chinese reading development. Ho and Bryant (1997c) proposed that the Chinese literacy acquisition always started with a visual phase and later progressed to phonological stage. Consistent with this proposal, the study of Chan and Siegel (2001), which included 94 primary school children in Hong Kong, noted that semantic and visual errors were much more frequently observed in children of poorer reading ability and normal children in lower grades whereas typical children in higher grades were prone to making more phonological mistakes. Hence, age-appropriate morphological awareness and visual-verbal PAL might assist them in overcoming potential reading difficulties, thereby relieving the impact of SSD in reading during preschool years. Since both morphological awareness and visual-verbal PAL skills of the participants were not investigated in the present study, future studies may further examine their roles by controlling their effects.

Besides, the results showed that speech sound ability failed to significantly explain variance in literacy, suggesting that the importance of phonological processing in Chinese reading may not be as prominent as in alphabetic scripts. This may be attributable to two reasons. Firstly, due to the opaque orthography-phoneme conversion in Chinese, it is understandable that phonological deficits may not be the core cognitive difficulties demonstrated by children with RD. Secondly, kindergarten teachers in Hong Kong, instead of explicitly teaching the children to look for sound cues from the phonetic components, emphasize the necessity to memorize the pronunciation of the whole word. In other words, despite the usefulness of phonological regularity in Chinese character reading, studies revealed that Hong Kong children rarely make use of the phonetic component for sound cues until the age of six (Ho & Bryant, 1997b; Ho et al., 2000) as employing this strategy for sound cues requires phonological information of a reservoir of words (Ho & Bryant, 1997c). The highest word reading score obtained by the participants in the present study were 17 out of 55, which was still rather limited. There was low likelihood for the children with ages ranging from 49 to 60 months in this study to acquire the concept of deriving sound cues from the phonetic radical, suggesting the weaker relationship between PA and character reading during preschool years.

Although Multiple Deficit View seemed to gain more support from the findings, it was noteworthy that Core Phonological Deficit Hypothesis could not be completely challenged. The insignificant association between speech sound ability and character reading was possibly due to the failure to meet certain conditions as suggested by some researchers. These included the persistence of SSD, SSD severity and types of speech sound errors.

In terms of persistence of SSD, the “Critical Age Hypothesis” posits that RD is only contributed by speech difficulties that lasts till the age of 6;9 (Nathan et al., 2004), in which the demand for literacy during primary schools is significantly greater than that in preschools now. Due to the small sample size and thus consideration on statistical power, persistence of speech problems was not put into the model for analysis. Although there are no similar studies for Cantonese-speaking children to date, the high normalization rate of SSD in this study (i.e. 31%) implies that “Critical Age Hypothesis” may also be relevant among Cantonese-speaking children. Hence, there is possibility that the linkage between isolated

SSD and RD is apparent only when the speech problems persist to the time when the child starts to read considerably.

Concerning the severity of SSD, Bird et al. (1995) proposed that the number of articulation errors made was predictive of the literacy success. Nonetheless, the SSD severity of their participants was restricted to the “severe” range. Gernand and Moran (2007) endeavored to prove that mild to moderate SSD was adequate to pose threat to PA and reading by including children with a range of SSD severity. Yet, only 6-year-old children took part in that study and the findings may fail to generalize to preschoolers. Although Anthony et al. (2011) modified previous studies and suggested that preschoolers with only moderate SSD could already add risk to word reading, the contribution of mild SSD to English reading acquisition during preschool years was still unknown, not to mention to Chinese reading outcome. Hence, Core Phonological Deficit Hypothesis may be valid in certain range of severity but not in others. Although severity can to some extent be reflected in PICC, the speech sound measures of the present study, it fails to account for the severity rating completely. It is known that the more unintelligible one’s speech, the more severe his/her SSD problem. However, we did not take into account of the speech sound pattern profile, along with the children’s intelligibility at conversation level which may be different from that at word level observed during the study. In fact, it had been set forth that the association between SSD and PA impairment was the strongest when atypical error patterns were present (Leitao & Fletcher, 2004; Preston & Edwards, 2010). For instance, a Cantonese-speaking child exhibiting backing has his/her SSD in a more severe range than another who demonstrates distortion only (So & Dodd, 1994), even though they may have the same PICC. Therefore, we could not rule out the possibility that the association between speech sound and reading was obscured by the measure of PICC.

Limitations and Future Studies

The major limitation is that the sample size is small, thereby making some interpretations of the results difficult. Not only does larger sample enhance the statistical power, it also enables more potential covariates such as frequency of atypical speech changes, maternal education level and persistence of SSD to be put into the regression model.

Despite the limitation, the findings of the study provide us some clear directions to future study in this area. For instance, longer term follow-up is required for these children to determine whether there are influences of persistent SSD and/or severe SSD on literacy outcomes in Cantonese. Besides, PICC at Time 1 can just account for 26.5% of the variance in the outcome measure, leaving a large proportion of variance unexplained. Further study can focus on the factors that predispose Cantonese-speaking children to literacy difficulties so that early intervention can be warranted when risk factors are noted.

Acknowledgements

The author would like to express her heartfelt gratitude to her supervisor Dr. Carol To for her guidance and support throughout the study. Special thanks are also extended to Miss Kaylor Ng for her assistance in providing the raw data of the database. The author would also like to acknowledge all the participants and their parents for their generous participation in the study. Last but not least, the author’s deepest appreciation to the principals and teachers in AEFCHK-EFCC Po Nga Nursery School, Kowloon City Baptist Church Hay Nien Kindergarten, HKYWCA Lung Hang Nursery School, HKYWCA Tai Hon Fan Nursery School and TWGHs Liu Yan Tak Memorial Kindergarten for their kind arrangement in participant recruitment.

References

Anthony, J. L., Aghara, R. G., Dunkelberger, M. J., Anthony, T. I., Williams, J. M., & Zhang, Z. (2011). What factors place children with speech sound disorders at risk for reading problems?. *American Journal of Speech-Language Pathology*, *20*(2), 146-160. doi: 10.1044/1058-0360(2011/10-0053)

British Dyslexia Association. (2007). Retrieved March 23, 2014, from British Dyslexia Association website: http://www.bdadyslexia.org.uk/about-dyslexia/further-information/dyslexia-research-information-.html

Bird, J., Bishop, D. V. M., & Freeman, N. H. (1995). Phonological awareness and literacy development in children with expressive phonological impairments. *Journal of Speech and Hearing Research*, *38*(2), 446.

Bradley, L., & Bryant, P. (1985). *Rhyme and reason in reading and spelling*. Ann Arbor: University of Michigan Press.

Bursac, Z., Gauss, C. H., Williams, D. K., & Hosmer, D. (2007). A purposeful selection of variables macro for logistic regression. *Proceedings of the SAS® Global Forum 2007 Conference.* Cary, NC: SAS Institute.

Census and Statistics Department. (2012). *Hong Kong 2011 population census – Main report: Volume I.* Hong Kong: Census and Statistics Department.

Chan, C. K., & Siegel, L. S. (2001). Phonological processing in reading Chinese among normally achieving and poor readers. *Journal of Experimental Child Psychology*, *80*(1), 23-43. doi: 10.1006/jecp.2000.2622

Cheung, P., Ng, A., & To, C. K. S. (2006). *Hong Kong Cantonese Articulation Test.* Hong Kong: Language Information Sciences & Research Centre.

Elbro, C., Borstrom, I., & Petersen, D. K. (1998). Predicting dyslexia from kindergarten: The importance of distinctness of phonological representations of lexical items. *Reading Research Quarterly, 33(*1), 36–60. doi: 10.1598/RRQ.33.1.3

Gathercole, S. E., & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of memory and language*, *28*(2), 200-213. doi: 10.1016/0749-596X(89)90044-2

Gernand, K. L.,& Moran, M. J. (2007). Phonological awareness abilities of 6-year-old children with mild to moderate phonological impairments. *Communication Disorders Quarterly, 28*(4), 206–215. doi: 10.1177/1525740107311819

Ho, C. S. H. (2010). Understanding reading disability in the Chinese language: from basic research to intervention. In M. H. Bond (Ed.), *The Oxford handbook of Chinese psychology* (pp. 109-121). Oxford: Oxford University Press. doi: 10.1093/oxfordhb/9780199541850.013.0009

Ho, C. S. H., & Bryant, P. (1997a). Development of phonological awareness of Chinese children in Hong Kong. *Journal of Psycholinguistic Research*, *26*, 109-126. doi: 10.1023/A:1025016322316

Ho, C.S.-H. & Bryant, P. (1997b). Learning to read Chinese beyond the logographic phase. *Reading Research Quarterly* 32, 276–289. doi: 10.1598/RRQ.32.3.3

Ho, C. S. H., & Bryant, P. (1997c). Phonological skills are important in learning to read Chinese. *Developmental psychology*, *33*, 946. doi: 10.1037/0012-1649.33.6.946

Ho, C. S.-H., Chan, D. W., Chung, K. K-H., Lee, S.-H., & Tsang, S.-M. (2007). In search of subtypes of Chinese developmental dyslexia. *Journal of Experimental Child Psychology, 97,* 61-83. doi: 10.1016/j.jecp.2007.01.002

Ho, C. S. H., Chan, D. W. O., Lee, S. H., Tsang, S. M., & Luan, V. H. (2004). Cognitive profiling and preliminary subtyping in Chinese developmental dyslexia. *Cognition*, *91*(1), 43-75. doi: 10.1016/S0010-0277(03)00163-X

Ho, C. S. H., Chan, D. W. O., Tsang, S. M., & Lee, S. H. (2002). The cognitive profile and multiple-deficit hypothesis in Chinese developmental dyslexia. *Developmental psychology*, *38*(4), 543. doi: 10.1037/0012-1649.38.4.543

Ho, C. S. H., Law, T. P. S., & Ng, P. M. (2000). The phonological deficit hypothesis in Chinese developmental dyslexia. *Reading and Writing*, *13*(1-2), 57-79. doi: 10.1023/A:1008040922662

Ho, C. S.-H., Leung, M. T., & Cheung, H. (2011). Early difficulties of Chinese preschoolers at familial risk for dyslexia: deficits in oral language, phonological processing skills, and print-related skills. *Dyslexia*, *17*(2), 143-164. doi: 10.1002/dys.429

Ho, C. S. –H., Leung, K. N. –K., Yeung, P. –S., Chan, D. W. –O., Chung, K. K. –H., Tsang, S. –M., & Lee, S. –H. (2011). *The Hong Kong Reading Ability Screening Test for Preschool Children.* Hong Kong Specific Learning Difficulties Research Team.

Ho, C. S. H., & Ma, R. N. L. (1999). Training in phonological strategies improves Chinese dyslexic children's character reading skills. *Journal of Research in Reading*, *22*(2), 131-142. doi: 10.1111/1467-9817.00078

Ho, C. S. H., Ng, T. T., & Ng, W. K. (2003). A "radical" approach to reading development in Chinese: The role of semantic radicals and phonetic radicals. *Journal of Literacy Research*, *35*(3), 849-878. doi: 10.1207/s15548430jlr3503_3

Ho, C. S. H., Wong, Y. K., Yeung, P. S., Chan, D. W. O., Chung, K. K. H., Lo, S. C., & Luan, H. (2012). The core components of reading instruction in Chinese. *Reading and Writing*, *25*(4), 857-886. doi: 10.1007/s11145-011-9303-1

Hu, C. F., & Catts, H. W. (1998). The role of phonological processing in early reading ability: What we can learn from Chinese. *Scientific Studies of Reading, 2*(1), 55-79. doi: 10.1207/s1532799xssr0201_3

Lee, K. Y. S., Lee, L. W. T., & Cheung, P. S. P. (1996). *Hong Kong Cantonese receptive vocabulary test.* Hong Kong: Hong Kong Society for Child Health and Development.

Leitao, S., & Fletcher, J. (2004). Literacy outcomes for students with speech impairment: Long-term follow-up. *International Journal of Language & Communication Disorders, 39*(2), 245-256. doi: 10.1080/13682820310001619478

McArthur, G. M., Hogben, J. H., Edwards, V. T., Heath, S. M., & Mengler, E. D. (2000). On the "specifics" of specific reading disability and specific language impairment. *Journal of Child Psychology and Psychiatry, 41*, 869-874. doi: 10.1111/1469-7610.00674

McBride-Chang, C., Cho, J. R., Liu, H., Wagner, R. K., Shu, H., Zhou, A., ... & Muse, A. (2005). Changing models across cultures: Associations of phonological awareness and morphological structure awareness with vocabulary and word recognition in second graders from Beijing, Hong Kong, Korea, and the United States. *Journal of experimental child psychology, 92*(2), 140-160. doi: 10.1016/j.jecp.2005.03.009

McBride-Chang, C., & Ho, C. S. H. (2000). Developmental issues in Chinese children's character acquisition. *Journal of Educational Psychology, 92*(1), 50. doi: 10.1037/0022-0663.92.1.50

McBride-Chang, C., Liu, P. D., Wong, T., Wong, A., & Shu, H. (2012). Specific Reading Difficulties in Chinese, English, or Both Longitudinal Markers of Phonological Awareness, Morphological Awareness, and RAN in Hong Kong Chinese Children. *Journal of learning disabilities, 45*(6), 503-514. doi: 10.1177/0022219411400748

Metsala, J. L. (1999). Young children's phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology, 91,* 3–19. doi: 10.1037/0022-0663.91.1.3

Nathan, L., Stackhouse, J., Goulandris, N., & Snowling, M. (2004). The development of early literacy skills among children with speech difficulties: A test of the "critical age hypothesis." *Journal of Speech, Language, and Hearing Research, 47*, 377–391. doi: 10.1044/1092-4388(2004/031)

Ng, K. Y. M., To, C. K. S., & Mcleod, S. (2014). Validation of the Intelligibility in Context Scale as a screening tool for preschoolers in Hong Kong. *Clinical linguistics & phonetics,* (0), 1-13. doi: 10.3109/02699206.2013.865789

Pennington, B. F. (2006). From single to multiple deficit models of developmental disorders. *Cognition*, *101*(2), 385-413. doi: 10.1016/j.cognition.2006.04.008

Pennington, B. F., & Lefly, D. L. (2001). Early reading development in children at family risk for dyslexia. *Child Development, 72,* 816–833. doi: 10.1111/1467-8624.00317

Peterson, R., Pennington, B., Shriberg, L., & Boada, R. (2009). What influences literacy outcome in children with speech sound disorders? *Journal of Speech, Language, and Hearing Research, 52*, 1175–1188. doi: 10.1044/1092-4388(2009/08-0024)

Preston, J., & Edwards, M. L. (2010). Phonological awareness and types of sound errors in preschoolers with speech sound disorders. *Journal of Speech, Language and Hearing Research, 53,* 44. doi: 10.1044/1092-4388(2009/09-0021)

Raitano, N. A., Pennington, B. F., Tunick, R. A., Boada, R., & Shriberg, L. D. (2004). Pre-literacy skills of subgroups of children with speech sound disorders. *Journal of Child Psychology and Psychiatry, 45,* 821-835. doi: 10.1111/j.1469-7610.2004.00275.x

Rvachew, S. (2007). Phonological processing and reading in children with speech sound disorders. *American Journal of Speech-Language Pathology, 16*(3), 260-270. doi: 10.1044/1058-0360(2007/030)

Rvachew, S., & Grawburg, M. (2006). Correlates of phonological awareness in preschoolers with speech sound disorders. *Journal of Speech, Language, and Hearing Research, 49,* 74–87. doi: 10.1044/1092-4388(2006/006)

Shriberg, L. D. (1994). Five subtypes of developmental phonological disorders. *Clinics in Communication Disorders, 4*(1), 38-53.

Shu, H., & Anderson, R. C. (1997). Role of radical awareness in the character and word acquisition of Chinese children. *Reading Research Quarterly, 32*(1), 78-89. doi: 10.1598/RRQ.32.1.5

Shu, H., McBride-Chang, C., Wu, S., & Liu, H. (2006). Understanding chinese developmental dyslexia: Morphological awareness as a core cognitive construct. *Journal of Educational Psychology, 98*(1), 122. doi: 10.1037/0022-0663.98.1.122

Sices, L., Taylor, H. G., Freebairn, L., Hansen, A., & Lewis, B. (2007). Relationship between speech-sound disorders and early literacy skills in preschool-age children: Impact of comorbid language impairment. *Journal of developmental and behavioral pediatrics: JDBP, 28*(6), 438. doi: 10.1097/DBP.0b013e31811ff8ca

Siok, W. T., & Fletcher, P. (2001). The role of phonological awareness and visual-orthographic skills in Chinese reading acquisition. *Developmental psychology, 37*(6), 886. doi: 10.1037/0012-1649.37.6.886

Smith, S. D., Pennington, B. F., Boada, R., & Shriberg, L. D. (2005). Linkage of speech sound disorder to reading disability loci. *Journal of Child Psychology and Psychiatry, 46,* 1057-1066. doi: 10.1111/j.1469-7610.2005.01534.x

Snowling, M., Bishop, D.V.M., & Stothard, S.E. (2000). Is preschool language impairment a risk factor for dyslexia in adolescence? *Journal of Child Psychology and Psychiatry, 41,* 587–600. doi: 10.1111/1469-7610.00651

So, L. K., & Dodd, B. J. (1994). Phonologically disordered Cantonese-speaking children. *Clinical linguistics & phonetics, 8,* 235-255. doi: 10.3109/02699209408985309

Stanovich, K. E. (1986). Cognitive processes and the reading problems of learning disabled children: Evaluating the assumption of specificity. In J. K. Torgesen & B. Y. L. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 87-131). San Diego, CA: Academic Press.

Swan, D., & Goswami, U. (1997). Phonological awareness deficits in developmental dyslexia and the phonological representations hypothesis. Journal of Experimental Child *Psychology, 66*, 18–41. doi: 10.1006/jecp.1997.2375

Whitehurst, G. J., & Fischel, J.E. (2000).A developmental model of reading and language impairments arising in conditions of economic poverty. In D. Bishop & L. Leonard (Eds.), *Speech and language impairment: From theory to practice* (pp. 53-71). East Sussex: Psychology Press.

Wong, A. M. Y., Kidd, J. C., Ho, C. S. H., & Au, T. K. F. (2010). Characterizing the overlap between SLI and dyslexia in Chinese: The role of phonology and beyond. *Scientific Studies of Reading, 14*(1), 30-57. doi: 10.1080/10888430903242043

Zhu, Y. P. (1987). Analysis of cueing functions of the phonetic in modern China. *Unpublished manuscript, East China Normal University Shanghai.(In Chinese)*